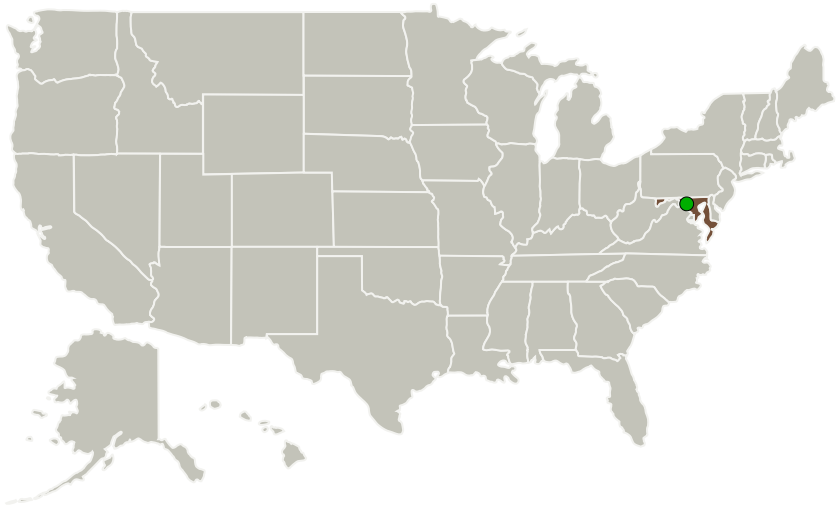
Proximity Glare Suppression using Carbon Nanotubes, Phase I

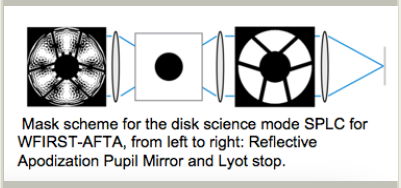
Completed Technology Project (2017 - 2017)

Project Introduction

Carbon nanotubes (CNT) are the darkest material known to man and are an enabling technology for scientific instrumentation of interest to NASA. The chemical vapor deposition (CVD) of carbon nanotubes directly onto high quality mirrors for diffraction suppression and stray light control is critical for use reflective nulling coronagraphs. The development of an integrated optical stack for these applications is new technology that has never been demonstrated. Sub-micron controlled patterning of carbon nanotubes for extreme stray light control must be made to be compatible with high reflectivity coatings without degrading the near diffraction limited surface figure on the underlying substrate. The entire optical stack; substrate, reflective coating and carbon nanotube forest, must be able to withstand high power laser pulses without damage and be robust to launch environments. This is critical to missions that require extreme nulling of bright sources adjacent to dim companions. The second component required for a nulling coronagraph is a sharp edge low scatter Lyot stop to block light. Etched silicon has been used as an entrance slit for instruments and have been successfully fabricated and coated with ultra dark nanotubes by proposal team members. The Principal Investigator at Lamba Consulting is a recognized expert in the development of carbon nanotubes, novel mirror substrates and coating technologies for space flight applications and has formulated a plan for fabricating and qualifying demonstration optics including for both a reflected apodization mirror and Lyot stop selectively coated with carbon nanotubes.

Primary U.S. Work Locations and Key Partners





Mask scheme for the disk science mode SPLC for WFIRST-AFTA, from left to right: Reflective Apodization Pupil Mirror and Lyot stop.

Proximity Glare Suppression using Carbon Nanotubes, Phase I Briefing Chart Image

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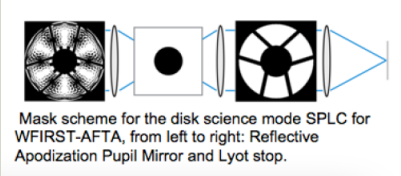
Organizations Performing Work	Role	Type	Location
Lambda Consulting	Lead Organization	Industry	
Advanced Nanophotonics, Inc.	Supporting Organization	Industry	Harwood, Maryland
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Images


Mask scheme for the disk science mode SPLC for WFIRST-AFTA, from left to right: Reflective Apodization Pupil Mirror and Lyot stop.

Briefing Chart Image
Proximity Glare Suppression using Carbon Nanotubes, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/126117)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Lambda Consulting

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

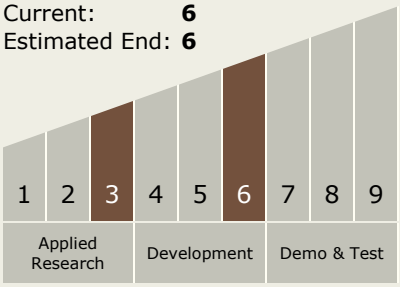
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
John Hagopian

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



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Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.5 Coatings